



ADAS-XIL and VTD: A Toolchain Qualification Cooperation

Patrick Weber (Bosch) and Sunitha Subramaniam (Hexagon)

EclipseCon 2022, 24.10.2022, Ludwigsburg

Agenda

- › Bosch: ADAS-XIL Toolchain

 - › Framework

 - › Qualification

- › Hexagon

 - › VTD

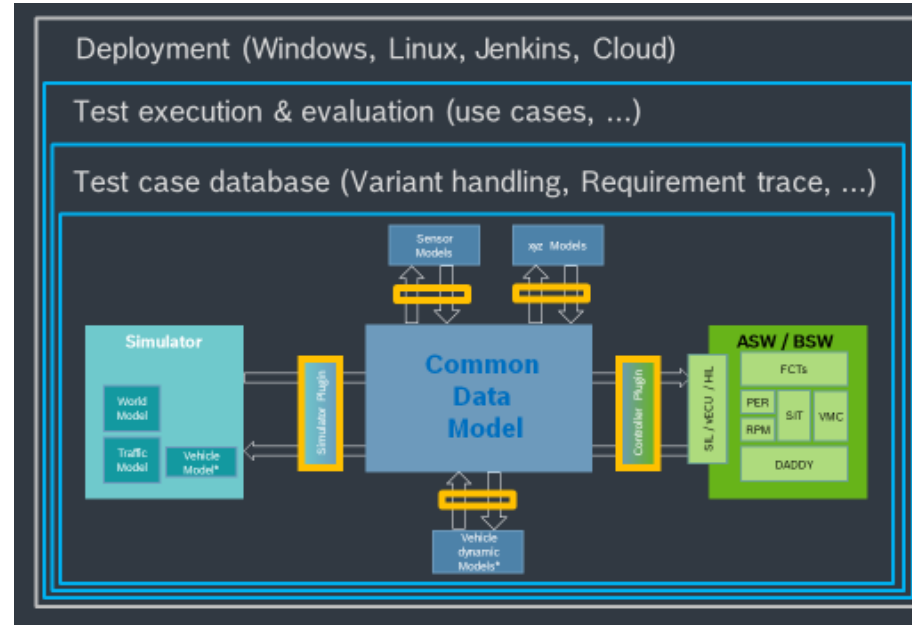
 - › Motivation



 - › Qualification

Using the , Sandwich Approach“



„Your tool, your choice“



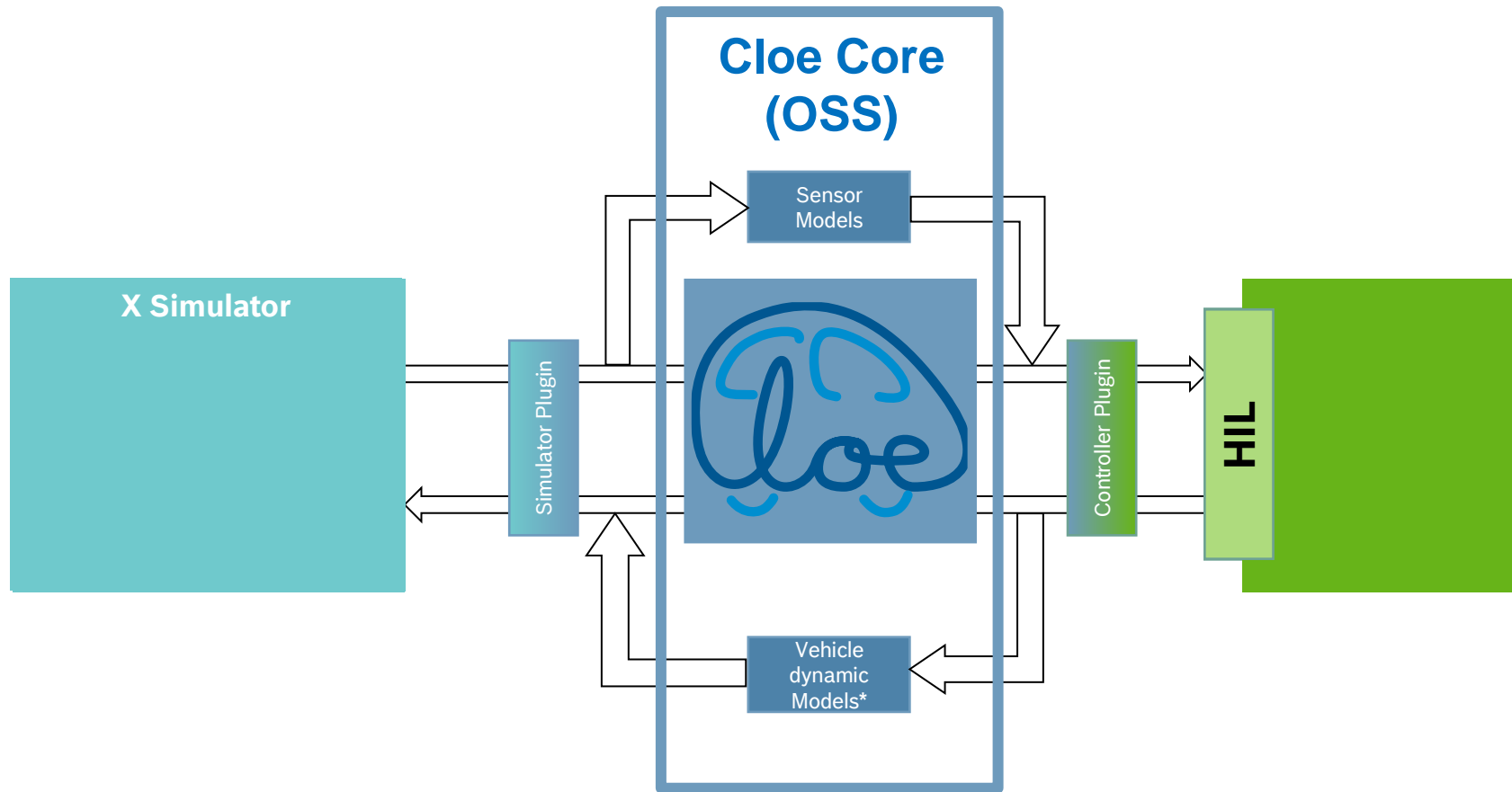
 Simulation core
 Simulation framework

Using **modules** (=microservices) that are **build together** within the customer projects to satisfy exactly their needs.

The **re-usable modules** have defined **interfaces** and are **glued together** with a **secret sauce** („simulation framework“) that is financed by OneDriving Software Project.

Modular ADAS XIL framework

PJ-SYM Framework concept – Feature Overview



Key features:

- Flexibility & Modularity
- Deployment
 - Linux
 - Windows (WSL2)
 - Jenkins
 - Cloud

One tool & user interface
=> multiple use cases:

- Function Development
- Application support
- Verification
- Validation support

Modular ADAS XIL framework

Simulation framework architecture

Meta-Database: make more out of the simulation data

Cloe ansible automation

Orchestration and execution platform (Jenkins, Windows (WSL2), Linux, ...)

EvalD

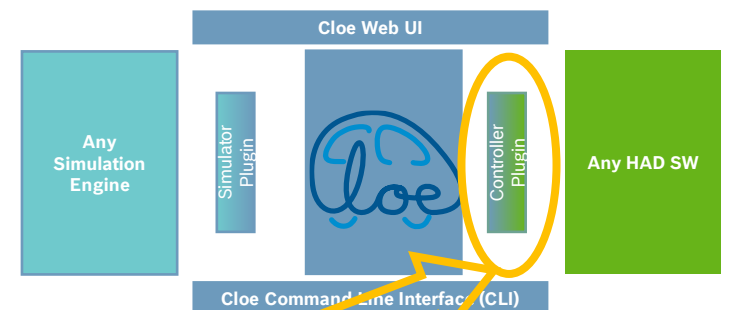
- Execution
- Evaluation

(Template) Testing Repo

- Test case handling
- Variant handling
- Scenario Road handling
- Requirement trace handling



Simulation
CLI & Core

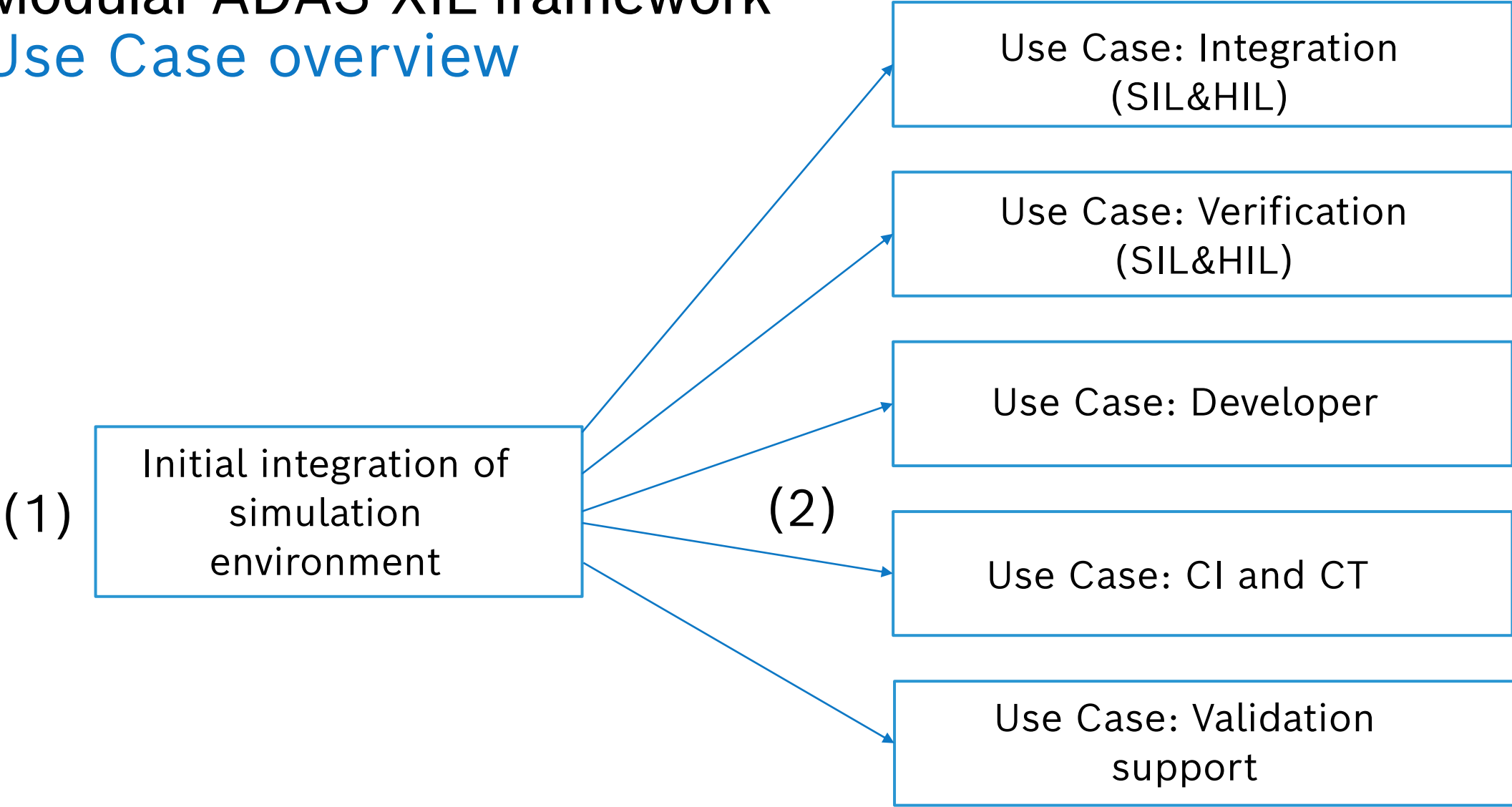


⇒ All parts of the framework is developed & tested independently from a direct customer

5 ⇒ Only connection is the controller binding

Modular ADAS XIL framework

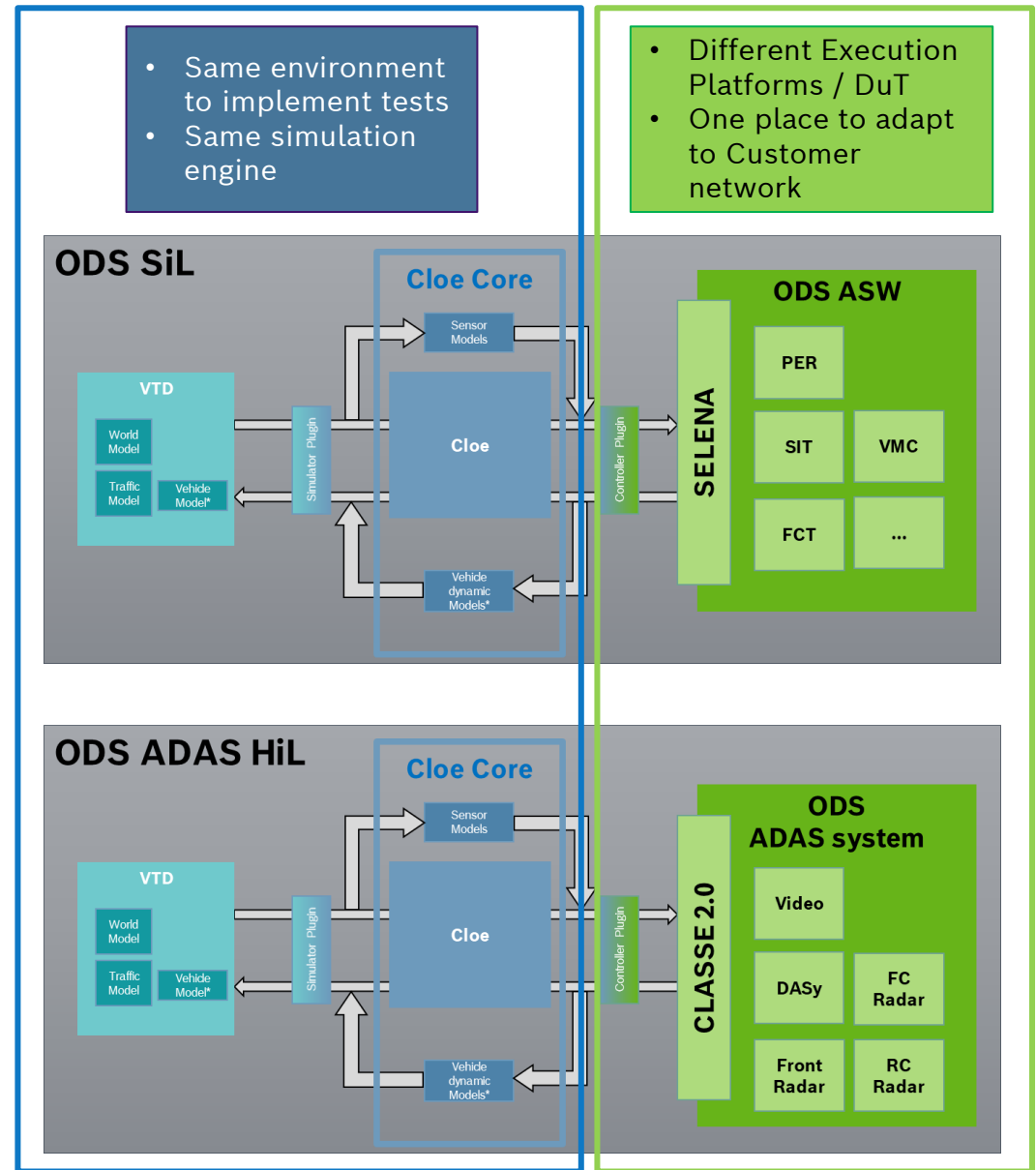
Use Case overview



Modular ADAS XIL framework

Verification strategy

- Test cases are generated and tested on SIL and HIL
 - Fast: SIL typically earlier available in project life-time
 - Cheap: Fewer HIL test systems required
 - Efficient: Reuse of requirement and test cases possible
- Flexible Use Cases:
 - ADAS HIL: Verification of ASIL A+B requirements (ISO 26262)
 - ADAS SIL: Developer and Performance testing on local developer PCs
 - ADAS HIL & SIL: Automated full test case execution
 - SIL => nightly example: project A: 2700 TC / night
 - HIL => weekly (planned)
 - ADAS SIL: Quality gate in the CI pipeline
- Future application:
 - Validation support, ...



ADAS-XiL Qualification

Why is it gaining more and more importance?

- › SOTIF level 3+ Systems: Distance based validation approach impossible → billions of test kilometers
- › Scenario based approach needed
- › Technological debt passed on from DEV to TOOLS that provide these methods

ASIL qualified Tools = ISO26262-8, Chap.11 → Safe tool internal signals

Conclusion: A tool without ASIL Qualification can never do an advanced ADAS simulation. You would never invest in validating/integrating an expensive simulation model in such a toolchain.

ADAS-XiL Qualification

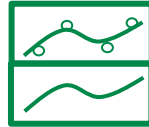
V&V activities

Contribution System Validation & Release

UN-ECE VMAD NATM 27th: AIII C

Performance M&S

- a) Performance Model Integration:
Bosch SW Radar-Location-Sensor
- b) S&M Validation: NCAP, Hands-free



SOTIF ISO PAS 21448

Lvl2+ Use Cases/Triggering Events

- a) Scenarios: Exit Lane scenarios
- b) Metrics: Lane similarity metrics



TDP FuSa: ISO 26262-8 Supporting processes, Chap. 11: Confidence in software tools

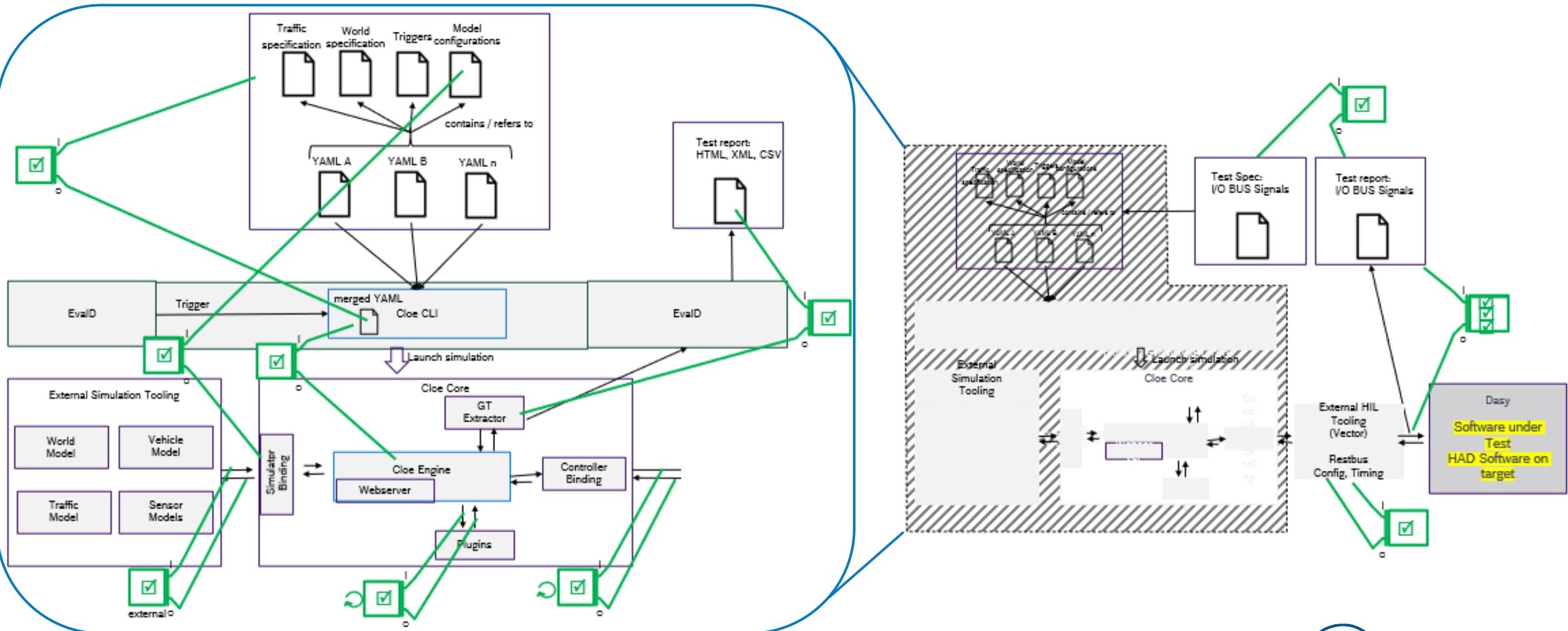
- a) Tool qualification: ADAS-XiL toolchain → ASIL B SIL+HIL (92 Test-series in 5 repositories)
- b) External qualification: e.g., with Hexagon, FAST
- c) Expert trainings: Classification, QM design



ADAS-XiL Qualification Strategy

SIL

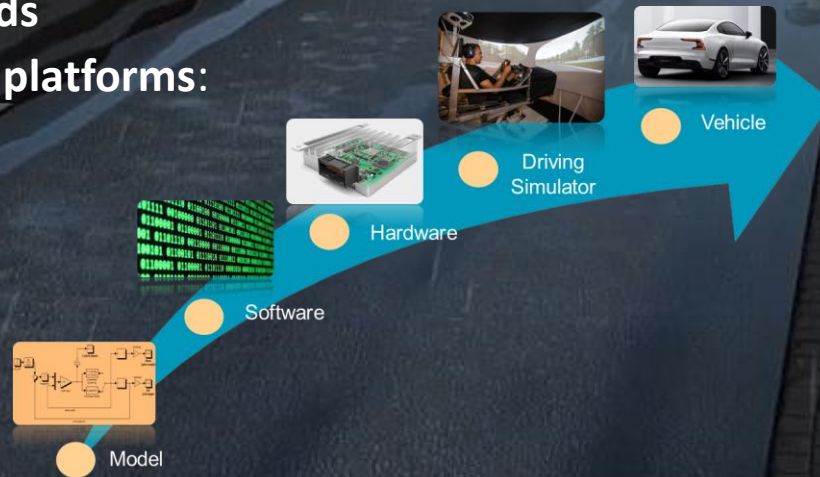
HIL



Why VTD?

VTD is an open and flexible environment simulation for ADAS and AD

- Simulate single components or full **ADAS / AD** systems
- Strong support for **open standards**
- **Flexible**: tailor VTD to your use case
- Physics-based **sensor models**
- Extensive library of **3D models** and ready-to-go **virtual worlds**
- Applicable to **numerous platforms**: MiL, SiL, HiL, DiL, ViL, ...

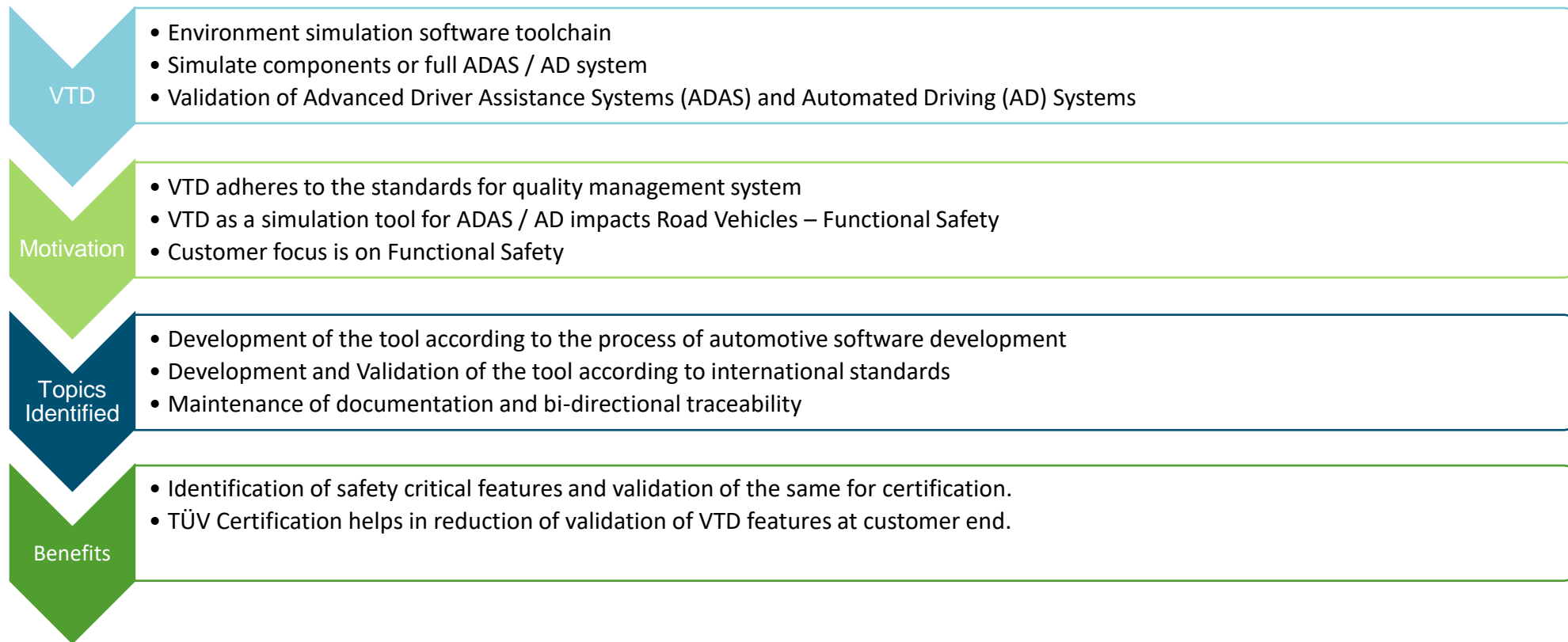


Virtual validation of safety critical systems require the complete toolchain to be qualified automotive-grade

- ❑ VTD is an environment simulation tool for ADAS / AD system
- ❑ Failure in the simulation environment might lead to safety impact
- ❑ Wrong values from the VTD simulation tool as well leads to **safety impact** on the complete tool chain like CLOE
- ❑ **Identification of these safety critical features** / use cases and performing safety-oriented analysis
- ❑ Goal: VTD shall be a **safe environment simulation** tool, which helps customers in the reliability of the tool

ASPICE is the central piece to automotive-grade qualification

- ❑ **ADAS / AD system** is considered as a **safety critical system**.
- ❑ **ISO 26262** relates to the behavior of electronic safety systems when they receive standard inputs and how to **mitigate** any **hazards** if they go wrong.
- ❑ **ASPICE** provides a framework to establish and evaluate the **process of automotive software development**.



Tool qualification strategy: taking a two-step approach

- Validation of release critical VTD features used by BOSCH
- Targeted for BOSCH tool chain qualification
- 138 features / Use Cases require verification by BOSCH
 - Vires Road Designer Version 4.5.6 - 31 of 34 tests implemented
 - Bosch Scenario Editor – 21 of 31 tests implemented
 - VTD API – 12 of 43 tests implemented
 - VTD API SCP – 26 of 30 tests implemented
- 90 total tests / test-series implemented
- Test cases for features / use cases which are QM level (not safety critical) or low priority was considered for verification in next releases of VTD.
- Verification of features / use cases identified for VTD helps in qualification of the complete Cloe tool chain.



VTD 2.2.0

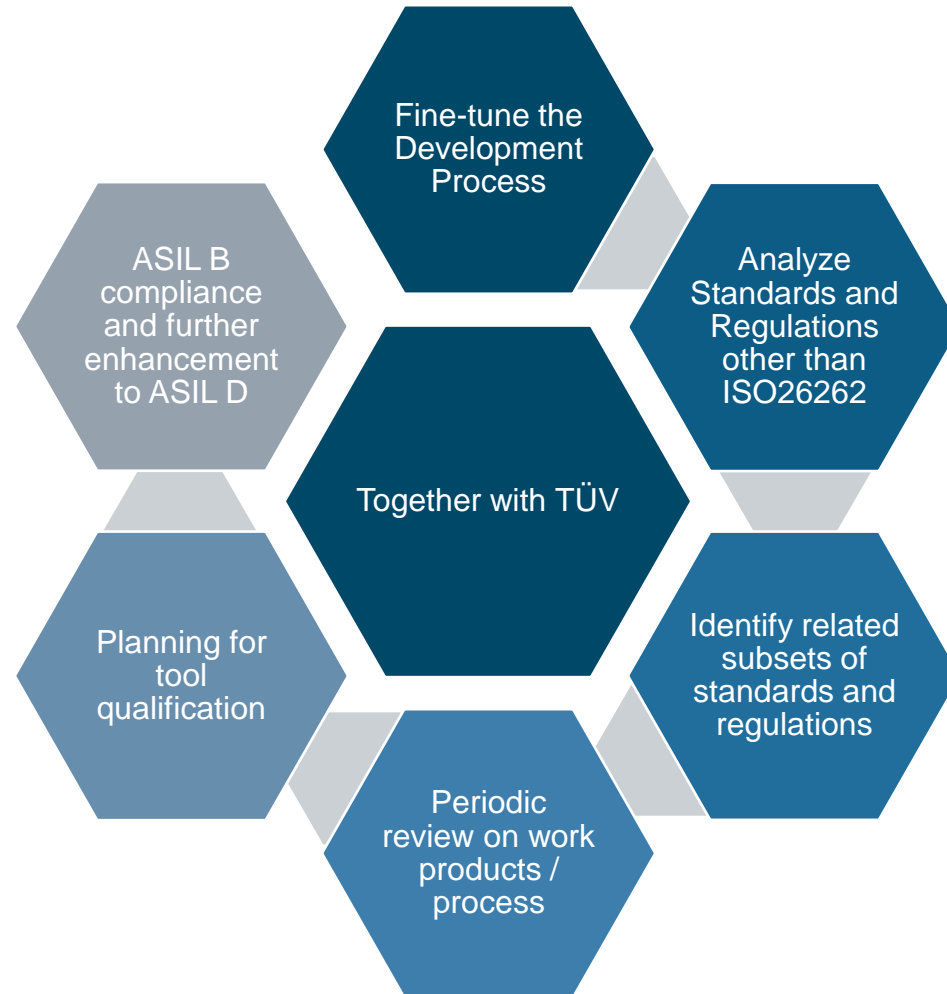
(Qualification together with Bosch)



- Will come with ASIL B compliance
- Enhancement to ASIL D compliance in later releases
- Helps customer in reduction of validation time of the tool chain
- Adherence to International Standards and Functional Safety

Next Generation VTD

Together with TÜV, we define all necessary steps to qualify our next generation product automotive-grade



Interested in finding out more?

Please contact us!

Patrickmarc.weber@de.bosch.com
Sunitha.subramaniam@hexagon.com